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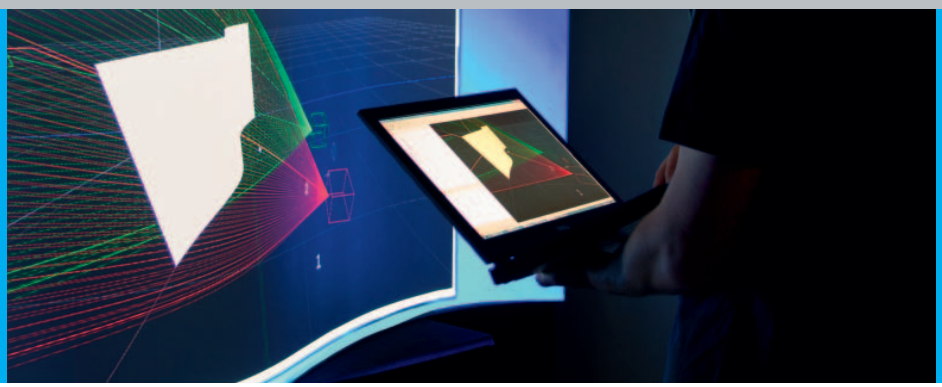

DESKTOP WARPING

Flight simulators, control rooms, multimedia installations: They all often require a complex setup consisting of several clustered projectors that project media content onto curved, geometrically complex surfaces. The resulting display is to fill the whole surface without overlaps of the individual projector images, and to offer a natural visual experience. Fraunhofer FOKUS has developed an automatic calibration software. This software is a component of the Fraunhofer FOKUS media player, which is already being used for the presentation of content on curved walls, such as dome cinemas.
The FOKUS Media Player is only suited for specific media content, such as movies, images, text, lines, or individual 3D objects. In some cases, however, not only this kind of content is to be displayed, but also desktop content from other computer programs, such as presentations, spreadsheets, computer games or simulations. Using the new desktop warping method, any desktop content can be adapted and projected onto irregular surfaces. The calculations to achieve this take place on the graphics board, which allows for a display without time delay.

Automatic calibration

In cluster projections, the individual projector images have to be rapidly coordinated with one another to give a single, homogenous picture. Fraunhofer FOKUS' automatic calibration software automatically adapts video content on the PC so that it accurately fits to the screening surface. To achieve this, the projectors generate test pictures, which are then recorded by one or more cameras. The automatic calibration software uses image processing algorithms for millimeter-precise detection of projector image alignment to the screen. Additionally, the luminosity (pixel brightness) of the image is measured. Using this data, the software automatically calculates the necessary rectification of geometry (warping) and adjustment of luminosity (blending). Those places on the screen where the individual projector images overlap are aligned with pixel accuracy. The image is adapted to the projection surface: It is distorted and aligned in brightness to render one single seamless high resolution picture. When changing the position of a projector and, accordingly, the picture it generates, the process can easily be started anew, and recalibration takes place within a few minutes.

Warping boxes and capture cards

Previously, when wanting to display desktop content that is not supported by the FOKUS Media Player on a projection surface, an additional computer or a so-called warping box had to be interposed between the graphics board and the projector. Warping and blending occurred on the warping box. An alternative approach was the use of capture cards. For example, if the pictures of a flight simulator were to be projected onto a curved surface, such as a 360° dome, the image data were transmitted to the capture card, which was installed in a second computer. The capture card then warped the

Thanks to desktop warping, a seamless, high resolution image is adapted to and projected onto the wave without a time delay.

image according to the projection surface at hand and finally transmitted the warped pictures to the projector, which played them onto the projection surface. Fraunhofer FOKUS has been successfully employing this technology for several years. However, the problem with using either warping boxes or capture cards is that the additionally interposed hardware causes a delay in the content display. This is problematic especially for simulators and computer games: Here a response to user input should be generated as quickly as possible, so that a natural interaction is guaranteed while the user is operating the program.

Warping and blending directly on the graphics board

The new desktop warping method, which was recently developed by Fraunhofer FOKUS, offers a solution to this issue. With this technology, necessary adjustments of content to irregular screen surfaces take place directly on the driver unit of the high-capacity graphics board. The driver warps the Windows desktop, so that it appears as a seamless, uniform image on the projection surface. Because no intermediate step is needed in this setup, the output of the content is faster and takes place without delay. Even though capture or framegrabber cards are still needed for some application scenarios (both adapt data format and image quality of cameras and are used, for example, when images are to be adjusted and projected onto a surface directly from a camera), FOKUS' desktop warping technology constitutes a considerable improvement compared to previous solutions.

Any software? Any software!

The desktop warping approach offers an additional advantage: Any image content that can be displayed on a computer monitor can now be played on curved screens. A specific media player is no longer required, and even special software, such as the 3D engine of a flight simulator, does not have to be changed in order to be suited for calibrated projection. Thanks to FOKUS' desktop warping software, content from any source is available for projection directly from the desktop. Even for PC clusters, as they are often used for complex simulations, the method functions without difficulty. Thus, all desktop content can be adapted to the geometry and reflection characteristics of the projection surface, and played onto it, in real-time.

Cooperation with NVIDIA, Fields of Application

In cooperation with the graphics processor manufacturer NVIDIA, Fraunhofer FOKUS has developed a system service, which integrated the desktop warping method into the NVIDIA graphics board driver unit by employing the warping and blending feature set. The technology can be utilized for simulators, e.g. product simulations, for gaming, multimedia installations in the areas of advertising, entertainment, events and on stage. Another application field is in control rooms for surveillance and security (e.g. in power plant control panels or control centers on space travels).

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